THE REORGANIZATION OF SECONDARY EDUCATION IN NEW HAMPSHIRE. II[1]

H. A. BROWN
Deputy State Superintendent, Concord, New Hampshire

III. THE TYPE OF RURAL HIGH-SCHOOL PLANT

A new type of rural high-school building is being evolved which is especially adapted to carrying on industrial courses in agriculture and domestic arts. The school plant of one school which has undergone transformation in the last four years and has had an entirely new building constructed is mentioned to show the trend of affairs in this connection. Four features of this school plant are important, as they will belong to every rural high-school plant when these schools are fully readjusted to the needs of the community. These features are: (1) the greenhouse; (2) the dairy laboratory; (3) the domestic-arts department; and (4) the shops, including a carpenter shop and a blacksmith-shop.

Located on the south side of the building and connected with it by a covered passage is a greenhouse for use in connection with the courses in agriculture. It is 28 feet long and 18 feet wide. The greenhouse is heated by a special hot-water heater in the basement of the main building. The greenhouse contains soil benches around the walls on four sides, and a center bench with soil to the depth of 6 inches for experiments and for growing plants. In the greenhouse much practical work is done in connection with the study of the elementary principles of plant life, soils, fertilizers, the selection and testing of seeds, the care of plants under glass, and, in fact, in nearly all of the work in agronomy and horticulture. The use of the greenhouse makes it possible to do a large amount of practical laboratory study in connection with these two courses. The cost of the greenhouse was $500; the heating apparatus cost $250 additional.

The basement of the main building contains a dairy laboratory with cement floor, cabinets, tables, water connections, and suitable

[1] Continued from *School Review*, XXII (March, 1914).

apparatus. The equipment includes a Babcock milk-tester, a De Laval separator, a Sharples separator, and $200 worth of other apparatus.

The kitchen and dining-room are located on the third floor. The kitchen is provided with two cooking-tables so placed as to form an oblong with openings at each end. It will accommodate a cooking class of twelve girls. The room also contains a modern range and hot-water boiler, a porcelain sink, a large dish cupboard, and ample drawer room. The sink is provided with both hot and cold water. The cooking-tables are so constructed that each girl has the use of two table drawers, and below them a cupboard. Each student has individual equipment for her own use. Adjoining the kitchen is a commodious dining-room adequately equipped for serving. The equipment for cooking and serving is as complete as would be found in the home of a family of average means. More would be unjustifiable.

The old school building, which is situated just back of the new building, is used for shops for the two courses in farm mechanics. One, the forgeshop, is located in the basement and is designed and equipped for teaching forging and farm blacksmithing. The other is the woodshop and occupies the first floor; in it a year's work is given in woodwork and farm carpentry. The carpenter shop is equipped with woodworking benches and a set of tools for each, and a general set of tools for the entire shop. The forgeshop is equipped with hand forges, anvils, vises, and blacksmith tools, including a blacksmith's tap and die set. In these shops the boys in the agricultural curriculum have daily practice in woodwork and farm carpentry and forgework and farm blacksmithing throughout two years.

IV. CURRICULUM IN MECHANIC ARTS

A program of studies has been developed in one of the smaller industrial cities in the state which seems to illustrate the kind of educational organization which is growing up in communities of this sort. So attractive has this proved to the students that the enrolment in the high school has increased in six years from 53 to 383. The program of this school consists of mechanic arts, domestic arts, commerce, and liberal arts. The large emphasis in the

mechanic-arts work is upon the educational value aspect rather than upon an attempt to develop specific skill in some particular vocation. Great stress is placed upon the development of mechanical intelligence and adaptability. It is held that whenever, by frequent repetition, any act becomes automatic it has thereafter little educational value. On account of this fact, many schools make the mistake of providing too elaborate equipment in the way of machinery so that the educative value of the work in mechanic arts is minimized.

The standard mechanic-arts curriculum of the state is outlined as follows: first year, algebra, English, biology, mechanical drawing, carpentry and wood-turning; second year, geometry, English, a modern language, pattern-making, molding and casting, forging; third year, physics, English, a modern language, machine-shop practice; fourth year, English, American constitutional history, chemistry, machine-shop practice.

Carpentry and wood-turning are not taught as a series of formal exercises but center around project work of considerable complexity. It is held that the skill needed in the various manipulations can thus be developed in a more economical manner. Mechanical drawing, constructional plane geometry, and constructional descriptive geometry are continued throughout the four years, although only one formal course in mechanical drawing is given in the first year. Elementary cabinet-making[1] is taught in the first year, and the pupils make tables, drawers, cabinets, drawing-boards, tee squares, bookcases, type cases, cabinet work for the physical and chemical laboratories of the school, appliances for the shop, such as screw clamps and tool cabinets and laboratory accessories. In doing this work practice is given as needed in measuring, sawing, planing, nailing, boring, chiseling, and gluing, all of which are exercises belonging to this kind of work. The fundamental principles of woodworking, as for example the making of mortise- and tenon-joints, are taught wholly in connection with projects and when needed.

In one of the high schools a complete set[2] of patterns for a speed lathe and the frame of a band-saw was made after some prelimi-

[1] Morrison, *New Hampshire School Report*, 1907–8, p. 283.

[2] *Ibid.*, p. 284.

nary work in making patterns of such things as pulleys, washers, and collars. "The problems involved in pattern-making are among the most educative of all school activities. Will the pattern 'draw'; must it be cored; is the design one that is practical from the molder's point of view? The first year's work with hand tools along straight lines and the second year's work with the lathe and its curved lines come together in pattern-making to the great delight of the pupil."[1] Many patterns are made and molded and after being cast and the processes of lathing, milling, and drilling are undergone, they become articles of practical use around the school or in the homes of the pupils. Forging is taught from the same point of view. Cold chisels, punches, lathe tools, iron links, rings for laboratory ringstands, bolts for fastening work to the table of the milling machine are some of the articles made.[2] Extensive use is made of the engine lathe.

The third and fourth years are devoted to machine-shop practice.[3] The work of these years is particularly rich in material for projects and they may be of such a character as to involve all previous work. This work opens up a wide field of applied mathematics which is one of the most valuable parts of the courses from an educational point of view. The experience of one school clearly demonstrates that work of this kind may lead to a higher form of applied mathematics than any ever before thought possible in a secondary school. The object is not to get a mechanical equivalent for thought but the aim is to enable the student to understand the formulae and the machines which he uses. The projects here involve such things as steam and gasoline engines, dynamos, motors, and lathes. The second year of machine-shop practice is devoted entirely to projects of considerable complexity. One high school reported having made last year four twelve-horse-power gasoline engines, one eccentric, two emery grinders, two six-horse-power gasoline engines, and one three-horse-power gasoline engine.

[1] G. H. Whitcher, quoted in *New Hampshire School Report*, 1907–8, p. 284.

[2] Morrison, *New Hampshire School Report*, 1907–8, p. 285.

[3] For this whole subject see: (1) *Standard Program of Studies for the Secondary Schools of New Hampshire*, 1912, pp. 166–70; (2) Morrison, *New Hampshire School Report*, 1911–12, pp. 224–53.

V. RECONSTRUCTED PEDAGOGY OF THE SECONDARY SCHOOL

Equally as important as the reorganization of the secondary school by the adoption of the newer curricula is that which involves readjustments in its pedagogy. Extensive changes are taking place in this field as well which amount to an almost complete reorganization of secondary methods of instruction.

No better example of the changes which are taking place in the teaching of secondary-school subjects can be found than that of instruction in Latin. Until recently the practice has been to give, in the first year, a very large amount of instruction in formal grammar and devote a good deal of time to memorization of forms independent of their use in reading. The new conception of Latin teaching which is taking form is that the pupil should be introduced to the subject, not by a systematic study of the grammar of the language, but by gaining a wide acquaintance with form and usage by reading the language extensively from the beginning. Several schools in the state have reorganized their Latin teaching on this basis and wherever the method has been tried under conditions at all favorable to its development a considerably greater power to read Latin has been developed and as a result a very much greater amount of Latin has been read in the school course.

This new method rests heavily upon the fundamental principle that the pupil can best be taught to read Latin only by reading it extensively and acquiring familiarity with forms and constructions and facility in their use by continually meeting them in their functional relations in sentences. For this reason the pupils begin to read Latin at once with no preliminary study of grammar. In order to read efficiently the individual must have a large vocabulary of words, phrases, and idioms which will function automatically in a reflex manner. Therefore, a valuable adjunct to the early reading is an abundance of quick-perception drill on words by the use of perception cards. The real principle underlying this new method is set forth by O'Shea in the following terms: "But in reading one may be able to use the sentence without being aware of its mechanical properties. It is a simple fact that one may react to grammatical forms without being able to describe them or place

them properly in a grammatical system."[1] It is a matter of common knowledge that children will learn to read efficiently and to talk correctly and not know a single fact of grammar. In fact, the only rational place for the study of grammar is after language has been mastered. The only natural and normal method of learning any language is to use it for a long time before its grammar is studied. A grammatical principle is of no value unless it generalizes a broad experience on the part of the pupil.

This whole discussion thus far may be summarized in one principle: it is entirely possible to learn to read a foreign language without first mastering the science upon which it is based, and, indeed, it may be learned in this fashion more economically and more expeditiously. Teachers of the classics, recognizing the force of these facts, have adopted a new point of departure and a new method of procedure in teaching to read the ancient languages.

The first step in Latin instruction in this new method is to teach a few common words and then proceed to use them at once in writing sentences upon the board for the pupils to read. The first lessons are taught entirely from the blackboard without the use of a book. Many sentences are written and read during each period. Such explanations in relation to form and construction as are essential to the progress of the reading are made orally by the teacher. New forms and constructions are always presented for the first time in sentences, and the pupil learns to react to them correctly by frequent repetition, and at this stage of his learning he is not required to describe or classify the various forms which he meets. This is an important part of the underlying principles of this method of Latin instruction—learning to react correctly to forms and constructions by using them constantly in sentences and reacting to them in perception card drill. All the forms which come within the scope of first-year Latin are learned in this way easily during the year. No attempt is made to have forms appear in any particular order. For example, *laborat* may be the first form of this particular verb to appear, and when the pupils have translated it and several other like forms correctly a number of times they always thereafter react to similar forms correctly. In

[1] M. V. O'Shea, *Linguistic Development and Education*, p. 309.

the same way the accusative or genitive of a noun may appear before the nominative. In a word, the object is to teach the pupil to read by reading extensively, and to lead him to react correctly to grammatical forms by wide experience in using them without making him focally explicitly conscious of a multiplicity of minute particulars of form and syntax which is fatal to the best development of reading-power. Each sentence at the beginning is pronounced clearly and distinctly by the teacher and the pupils repeat after him, several times at first, thus learning pronunciation in a rational manner from the lips of the teacher by imitation. After a few days of this practice the pupils begin to pronounce for themselves and do so independently thereafter under the guidance and direction of the teacher. Each lesson at first is read and translated several times so that each pupil gets abundant practice in reacting correctly to the various forms.

Each day a number of words, phrases, and idioms are printed on white cards of stiff material four inches wide and nine or ten inches long and a few minutes of very rapid quick-perception drill is given on these words. After a large supply of cards has accumulated the teacher uses fifty or sixty today and the same number tomorrow, but different cards, and so on until he has gone through the list of five or six hundred or more. He keeps going over these again and again and the drill is made very rapid. As fast as pupils can respond instantly and automatically to a word it is dropped out of the list for a time as new words are added. This drill is extremely valuable in developing a vocabulary and adds to efficiency in reading as nothing else can. Thus forms are first developed in sentences and in no logical order and made automatic by drill and by constant reading. In the perception-card drill the pupils respond to the form that appears on the card with the proper translation, whether it be a verb form, a noun, a phrase, or an idiom. The pupil never learns the declensions in order, but when *nautorum*, for example, appears on the cards the pupil responds by saying *of sailors*. If *laudat* appears he responds with the meaning, so with *laudamus* or *laudo*. If two meanings are possible he gives both. The work continues in this fashion with reading from the blackboard and perception-card drill with no emphasis whatever on

grammar and form. It is found that after a given form has occurred several times in the reading-lesson the pupils are able to react to it correctly, although they could not describe and classify it. The entire emphasis is put on the thought to be obtained from the Latin.

After about a month the class is able to begin to read from books. Many schools have for the use of their first-year class sets of several good beginners' books and several books of very easy connected Latin stories, a half-dozen or more in all. After a month of blackboard reading, the class can begin to read the easiest connected Latin stories which are usually found in the earlier parts of the beginners' books. A good deal of this kind of reading is done from now on and still new forms and constructions continue to be met and enough explanation given to enable the pupil to use them. At the middle of the year the pupils are reading intelligently connected Latin stories like those found in Collar, *Gradatim*, or Ritchie, *Fabulae faciles*. By the end of the year the pupils have read the equivalent of the amount of Latin in four or five ordinary beginners' books, have met and become acquainted in actual reading with all the forms included within the field of first-year Latin, have a large vocabulary acquired from extensive reading and perception-card drill, have the ability to read easy Latin with a proficiency never gained under the old method, see some meaning in Latin study, and enjoy the study of Latin. Nearly all the reading is done at sight in class.

The same general method is pursued in the other three years. Whatever grammar is taught in these years is presented through prose composition in which one lesson a week is given. Nearly all of the Latin is read at sight throughout the course. In the Senior year a thorough study of the fundamental principles of Latin grammar is made. This is meaningful to the pupils for the reason that concrete experience in using the language has preceded the abstract study of the science upon which it is based.

The reports of work accomplished by a few typical schools will indicate the manner in which the method is succeeding.

One school reports that the amount of reading done in the first year has been the equivalent of the amount found in five average

beginners' books. In the second year this school read Caesar's *Gallic War*, Books i–iv, and fifteen lives of Nepos. Three-fourths of this was at sight. In the third year the same school read Cicero's four orations against Catiline, the orations for the Manilian Law and for the poet Archias, all of Cicero's *De senectute*, half of Cicero's *De amicitia*, and twenty selections from Post's *Latin at Sight.* Seven-eighths of this year's work was done at sight. For the work of the fourth year the class read six books of Vergil and fifteen hundred lines of Ovid with three-fourths of the reading done at sight. Prose composition occupied one day a week throughout the course.

Another school which begins its Latin in the last half of the seventh year read in nineteen weeks the equivalent of Ritchie, *First Steps in Latin*, Ritchie, *Second Steps in Latin*, and Inglis and Prettyman, *First Book in Latin*, the first forty-three lessons. In the eighth year this school read: Ritchie, *Fabulae faciles*, entire; twelve selections from Collar, *New Gradatim;* D'Ooge, *Life of a Roman Boy;* twelve lessons from Latin dialogues; Books i, ii, iii, and iv of Eutropius; Brittain, *Introduction to Caesar*, thirty chapters; Caesar's *Civil War*, three hundred lines. This was all read at sight.

Some of the schools which are using this method of teaching Latin complete the preparatory work in three years and read college authors in the fourth year. One high school read in the Senior year last year Vergil's *Aeneid*, Books iv, v, and vi; Tacitus' *Germania* and *Agricola*, and Terence' *Phormio*.

Reorganization along important lines is taking place in the mathematics of the secondary school. A great humanizing[1] process is under way. This change is manifesting itself along two lines: (1) The first line of readjustment relates to the content of the various mathematics courses and is taking the form of the evolution of a type of mathematics which will function in the life of the individual. (2) On the pedagogical side a great deal less emphasis is being placed on formal lesson-setting, lesson-hearing, and assignments for home study, and a great deal more upon efficient classroom instruction and greatly improved methods of study.

[1] Slaught, "The Training of the Teacher of Mathematics," an address.

The first step toward improving the mathematical situation in the high schools came as a result of the repudiation of the doctrine of formal discipline. Not many years ago courses in elementary algebra in the first year of the high school universally consisted of little but mere extensive formal manipulation of symbols and highly abstract and often complex processes, with very slight application to concrete problems. This highly abstract work upon which immature high-school boys and girls spent a year had no relation whatever to the experiences of life and was little else than an abstract science of numbers.[1] The average high-school Freshman is incapable of carrying on the severe abstract reasoning necessitated by the more difficult parts of algebra, and consequently algebra has led to more discouragement and withdrawals from school than almost any other subject. The lack of vital connection with life and the absence of any end of value made the whole process artificial in the extreme to the pupil. The barrenness and abstraction which have characterized algebra have also found their way into geometry. As taught in the past this subject has consisted of abstruse logic in the form of an abstract deductive science as remote as anything could be from the interests of adolescent boys and girls.

The situation has been greatly improved in recent years. In the first place, the aim of the first-year algebra is now more than ever before to train pupils in the solution of problems[2] by means of the equation, though this practice is by no means yet universal. The purpose is that the work shall be not demonstrational but concrete and shall avoid abstract formal manipulation. The best thought at the present time sanctions the introduction of only so much theory and formal manipulation as will give a mastery of the equation as a tool for problem-solving. The equation is introduced at the very first and a readjustment and rearrangement of material takes place throughout the course in order that it may be made use of in the widest manner in the solution of problems

[1] Brookman, "First Year High School Mathematics," *Teachers College Record*, X, 46–62.

[2] "Report of the Committee of the Central Association on Algebra in the Secondary Schools," *School Science and Mathematics*, November, 1907.

from the beginning. For example, quadratics are introduced very early in the course for the reason that thereby an entire new field is opened for problem work. A first-year course in algebra along these lines is concrete, is an interpretation of real life, begins with the interests and experiences of the pupils, and deals with real situations. The same intense interest and the same connection with life ought to be found in the algebra class as obtains in the class in cooking and the class in machine-shop practice. First-year algebra, according to the newer ideals, must be an instrument which can be used for a practical purpose in life and not a bundle of highly abstract theories. The recondite logic of the subject must be banished from the first year and the work made to center around the equation and the problem for practical purposes and rational ends.

The same idea holds in the reorganization of geometry. The central aim toward which we are working here is applied problems.[1] Gradually the content of the geometry course is being rebuilt and the shopwork in mechanic arts, some of the domestic-arts courses, the work in physics, and nearly all the vocations furnish many concrete problems. It is entirely possible that the truths of geometry may be developed thus in connection with the experiences of the pupils and come in concrete form from life instead of being handed down from the days of Greek philosophy in the form of organized logic suitable only for mature and mathematically inclined minds. The work of a few teachers here and there furnishes abundant proof that *applied problems* may be made the basis of the course in geometry and that around these the pupil may organize his knowledge and construct a science of geometry. It is easy to see in the present trend of thought here the complete reorganization of the content of geometry and the elimination from the second year of high school of the present course with its old Greek content and its difficult abstractions and emphasis on formal memory work.

Except for the few who are so constituted by nature that they have a natural bent for higher abstract mathematics, the algebra and geometry of the first two high-school years ought to be so

[1] Millis, "Real Problems in Geometry," *Teachers College Record*, X, 16–45.

reconstructed that those parts which are unrelated to the experiences of life should be eliminated. That is, there is a sufficient field of applied mathematics in which the pupil may with greater profit spend his time.[1] This idea has found concrete expression in the state in the complete abandonment of the formal courses in algebra and geometry in the curricula in agriculture, commerce, and domestic arts and the substitution of such courses as farm arithmetic, household arithmetic, and practical mathematics[2] in the attempt to develop a type of mathematics which will function in life. In a word, the mathematics situation is being rapidly reorganized in the state along the lines of the elimination of the traditional formal courses from all but the college-preparatory curricula and the substitution of courses in applied mathematics, as fast as they can be worked out in a systematic manner.

Another line of improvement in the mathematics situation in the college-preparatory curriculum is the concurrent teaching of algebra and geometry, which is a common practice now in the state. The main emphasis during the first year is on algebra, but a great deal of related geometry is taught. In the second year the work centers around geometry with the infusion of considerable associated algebra. Those parts of both subjects which are too formal and abstract for high-school pupils have been omitted. The whole subject has been made more concrete and practical, more problems are introduced, and the work is related in a more vital way to the experiences of life. Thus the subject is within the grasp of the average boy and girl, is intelligible, and has a meaning. The interweaving of algebra and geometry renders it possible for algebra to make geometry more intelligible and for geometry to illustrate the facts of algebra. The whole learning-process is made more rational and economic; the college-entrance requirements are fully met. The student does not drop his algebra at the end of the first year but his grasp on it continues to increase during the

[1] Morrison, "Reconstructed Mathematics in the High School," *Thirteenth Yearbook of the National Society for the Study of Education*, Part I, pp. 9–31.

[2] This is the name applied to a course in the agricultural curriculum which includes: (1) the algebra of the equation; (2) the applications of geometry to practical measurements; and (3) the elementary principles of surveying.

second year by constant use of it in expressing the facts of geometry; he is thus better prepared for work of an algebraic nature in the third or fourth year of his course.

The experience of a school in the state may serve to illustrate the advance which has taken place in the pedagogy of secondary mathematics. As in nearly all schools, it had been the custom in this school to assign a lesson in algebra from the textbook on one day and on the next to hear it recited. Becoming dissatisfied with the meager results obtained by this method of procedure, the books were taken away from the class and the recitation period devoted wholly to teaching and drill work alternated with recitations. The first step in teaching a principle was to draw from the class by questions any facts which they already knew which might serve as a basis for interpreting the new principle. In most cases this could be done in ten minutes. This is one of the most important steps in teaching. It is the process of bringing the mind of the pupil into a condition of apperceptive receptivity, as Hamilton terms it, so that it may have a body of related ideas with which to grasp, interpret, and assimilate the new principle. When this step was complete and the existing mental content of the pupils had been made available for interpreting the new idea, the teacher proceeded to give the class a brief, clear-cut, concise explanation of the process. It may be laid down as a principle that learning is always most economic and expeditious when the pupils' first view of a new subject comes from the teacher orally with abundant illustration and demonstration.[1] Three or four more examples were treated in this manner, after which the entire class was sent to the board for the rest of the period to solve examples dictated by the teacher. Sometimes ten or fifteen examples were placed on the board to be worked before the next period, but the reliance was largely on efficient instruction and effective drilling in the class period. On the day following the presentation of the principle, the books would be handed out and the class would work at their seats or at the blackboard on examples of the same kind, the teacher going among them, giving a suggestion here or a hint or a criticism there and keeping the class at work at concert pitch. Ordinarily

[1] W. H. Pyle, *Journal of Educational Psychology*, I, 475–76.

several days of work would follow in which the entire class would work at the board as the teacher dictated examples. Finally would come a day for recitation and for rounding up the whole matter. Now each pupil solved one or more examples at the board and explained them. Before the topic was left a thoroughgoing test was given on it, and if the class could show an average of 85 per cent or more a new topic was taken up. It was found that it was necessary for the pupils to do little or no home work in algebra. The important thing was the quality of the class instruction and the effectiveness of the drill.

A class of eighth-grade pupils was started in algebra at the beginning of the next year as an experiment and for the purpose of securing a comparison. The high-school class was taught this year by the traditional method of assigned lessons, home study, and hearing of recitations. The eighth-grade class devoted one twenty-five minute period a day to algebra, had no assigned lessons, no textbook study, and had textbooks in their hands only when they were doing examples at the board. The work was accomplished by skilful presentation of principles by the teacher along the lines previously indicated and by effective blackboard drill during the class period. The eighth-grade class covered during the year the same ground as the high-school class, and at the end of the year on the same examination, covering the work of the year, averaged about 10 per cent higher than the high-school class. The two classes were of approximately equal ability. The interest which the eighth grade manifested in the work was marked.

This description of the work of one school serves to illustrate the trend of affairs in the state, namely, to depend more and more upon a high quality of class instruction in mathematics rather than assigned lessons, home study, and formal recitations on what has been studied at home. In the best schools great emphasis is put upon efficient study in school. Several schools have rooms large enough to accommodate all the pupils in the school, which are used as study-rooms with a teacher always in charge. Those who have observed the work of these schools declare that one hour of study under these conditions which are most favorable to study is worth three of ordinary study at home.